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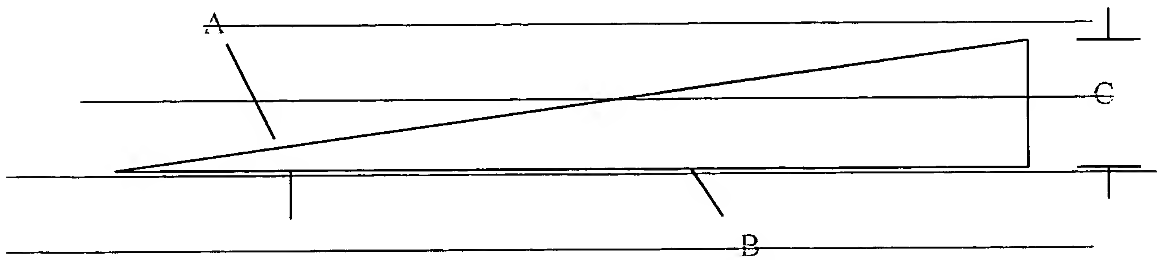
Marked-Up Copy of 'Brief Summary of the Invention- Objectives and Advantages' [with additions underlined and canceled language having strike-through markings]

BRIEF SUMMARY OF THE INVENTION - OBJECTIVES AND ADVANTAGES

The primary object of this invention is to provide a marine reaction thruster that enhances the operating efficiency of a marine engine at least twenty percent over that possible through the use of conventional propulsion systems of comparable size. It is also an object of this invention to provide a marine reaction thruster that is simple and cost effective to manufacture. A further object of this invention is to provide a marine reaction thruster that is easily and cost-effectively maintained. It is also an object of this invention to provide a marine reaction thruster with durable construction for long-term use. A further object of this invention is to provide a marine reaction thruster that is less dangerous to marine life than conventional propulsion systems. It is also an objective to provide a marine reaction thruster that is configured and positioned for reduced risk of damage by reefs, sandbars, and other underwater obstacles. A further object of this invention is to provide a marine reaction thruster having virtually silent operation, without vibration or propeller thumping.

As described herein, properly manufactured, and installed within the hull of a marine vessel, the present invention marine reaction thruster is designed to propel fluid by discharging it rearward with a reaction of increased force. This is accomplished by using a succession of

increasingly smaller propellers mounted on the same drive shaft within a conical/tapered housing and ensuring that each propeller has a maximum the pitch angle of approximately 10° to 12°. Pitch angle is defined by the ~~following~~ diagram in Fig. 16.



~~A= 10°-12° pitch angle~~
~~B= propeller circumference~~
~~C= propeller pitch – theoretical distance the propeller would advance in one revolution~~

The constant volume of fluid moving across the successively smaller propellers, in combination with the decreasing cross-sectional dimension of the propeller housing, sequentially increases the velocity of the seawater moving through the housing as it passes each propeller. An example of how the present invention causes increased operating efficiency over conventional marine propulsion systems is identified below. If the first propeller of the present invention propeller would be made with a diameter dimension of approximately ten inches and a pitch of approximately five-and-one-half inches, it would move approximately one-hundred-seventy-one cubic inches of fluid in one revolution. The next smaller propeller mounted on the same drive shaft would then be approximately nine-and-one-fourth inches in diameter and have a pitch of approximately six-inches. Since the volume of the fluid passing the second propeller is the same as that moving past the first propeller, the velocity of the fluid has now accelerated approximately 1%, generating a thrust reaction for the fluid as it approaches the third propeller. Then, if the third propeller is made with a diameter dimension of approximately eight inches and a pitch of approximately six-inches, and if its overall pitch angle is maintained at approximately 11°30', the third propeller will further increase the velocity of the seawater

moving rearwardly within the conical/tapered housing. When a fourth propeller is made with a diameter dimension of approximately seven-and-one-half inches and a pitch of approximately six-and-one-half inches, and its is mounted on the same drive shaft behind the other three propellers, and further where the discharge opening of the conical/tapered housing is approximately three inches in diameter (or approximately 9.42 square inches), the velocity of the one-hundred-seventy-one cubic inches of seawater as it exits the discharge opening is increased by approximately 20%. Further, as a result of the design of a keyhole-shaped opening in a cover plate mounted flush with the associated marine hull and aligned with the inlet opening of the present invention's conical/tapered housing, a large volume of seawater is drawn up into the conical/tapered housing without cavitation when the hull moves in a forwardly direction. The narrow end of the keyhole shape must face the bow of the associated marine hull, whereby the laminar flow of seawater across the forwardly moving hull is caused to form eddys at the outside edges on the narrow end of the keyhole-shaped opening and seawater to thereafter flow into the conical/tapered housing at the center of its leading edges, making a right angle or knee turn (genuflect) into the keyhole-shaped inlet opening. Rounded edges on the narrow end of the keyhole-shaped opening will cause the eddys to form, and prevent the seawater from bypassing the opening. However, the efficiency of seawater inflow is increased by use of inwardly sloping edges adjacent to the narrow portion of the keyhole-shaped inlet opening. The larger and wider rear portion of the keyhole-shaped opening can also be angled or otherwise made sloping on its rear top surface to enhance upward seawater flow into the conical/tapered housing and maximize efficiency. Thus the eddys which are formed in the narrow end of the keyhole-shaped inlet opening redirect the inertial energy of the laminar flow to move upward (genuflect) into the conical/tapered housing of the present invention and

thereby induce the main flow of seawater to follow without protest. Due to the large amount of seawater induced to flow into the keyhole-shaped inlet opening, which prevents steam bubbles that are low in temperature and pressure from forming, cavitation is eliminated as the seawater moves toward the first propeller. Also, the present invention is easily maintained. The need to clean drag-producing debris from the present invention propeller blades, or the strut that supports the distal end of the drive shaft upon which the propellers are mounted, is reduced when a debris-cutting blade is positioned for rotation in front of one or more of the propellers, and optionally in front of the strut. The debris cutter in front of the strut may be larger that those positioned in front of the propellers. Since it is contemplated for the motor connected to the drive shaft to always have a right~~left~~-hand rotation, all components affected by drive shaft rotation will also have a right~~left~~-hand configuration, including the positioning of the cutting edges on each debris cutter used. Also, the front casting, inlet opening cover plate, and strut plate are removable for easy maintenance access to the strut, drive shaft, and propellers. In addition, failure of the present invention propellers is reduced since they are internally located within a protective conical/tapered housing that is further protected by a marine hull. Thus, unless there is a hull breach, the propellers are unavailable for direct contact with large marine life or underwater objects such as reefs and sand bars. Further, the fact that no transmission is required allows for a simple construction, and the present invention has a nearly silent operation that could benefit submarine vessels used in research and military applications. However, since no transmission is present, a change in the direction of movement for the marine hull associated with the present invention is preferably accomplished by a reverse and steering assembly positioned rearward from the discharge opening, which includes opposing rudders having Ackerman geometry that allows one rudder to move more that the other while the associated

marine hull is making a turn and the second rudder to move more than the first while making a turn in the opposite direction, for less disruption of the water and enhanced operating efficiency. Rearward movement of the associated marine hull is also simply accomplished by use of a movable gate within the reverse and steering assembly that deflects the seawater flowing rearwardly from the conical/tapered housing into a downward and forwardly direction under the hull. Sturdy, non-corrosive materials, and oversized fasteners, further make the present invention durable for long-term use.

While the description herein provides preferred embodiments of the present invention, it should not be used to limit its scope. For example, variations of the present invention, while not shown and described herein, can also be considered within the scope of the present invention, such as variations in the number of propeller blades used within the conical housing; the materials used for manufacture of the conical/tapered housing; the number, size, configuration, type, and positioning of bolts and/or other fasteners used to attach components of the present invention together and the conical/tapered housing in its usable position against the inside surfaces of the marine hull bottom and its transom; the length and width dimensions of the keyhole-shaped opening used to induce a large volume of seawater (genuflect) through the bottom surface of the associated marine hull as long as such dimensions remain in substantial proportion to the keyhole-shaped configuration shown and described herein; the safety precaution means used to prevent large objects from entering the keyhole-shaped opening in the marine hull in very large embodiments of the present invention, and the number of present invention thrusters that can be used in association with larger marine hulls, such as a submarine. Thus, the scope of the present invention should be determined by the appended claims and their legal equivalents, rather than being limited to the examples given.

pressure from forming, cavitation is eliminated as the seawater moves toward the first propeller. Also, the present invention is easily maintained. The need to clean drag-producing debris from the present invention propeller blades, or the strut that supports the distal end of the drive shaft upon which the propellers are mounted, is reduced when a debris-cutting blade is positioned for rotation in front of one or more of the propellers, and optionally in front of the strut. The debris cutter in front of the strut may be larger that those positioned in front of the propellers. Since it is contemplated for the motor connected to the drive shaft to always have a right~~left~~-hand rotation, all components affected by drive shaft rotation will also have a right~~left~~-hand configuration, including the positioning of the cutting edges on each debris cutter used. Also, the front casting, inlet opening cover plate, and strut plate are removable for easy maintenance access to the strut, drive shaft, and propellers. In addition, failure of the present invention propellers is reduced since they are internally located within a protective conical/tapered housing that is further protected by a marine hull. Thus, unless there is a hull breach, the propellers are unavailable for direct contact with large marine life or underwater objects such as reefs and sand bars. Further, the fact that no transmission is required allows for a simple construction, and the present invention has a nearly silent operation that could benefit submarine vessels used in research and military applications. However, since no transmission is present, a change in the direction of movement for the marine hull associated with the present invention is preferably accomplished by a reverse and steering assembly positioned rearward from the discharge opening, which includes opposing rudders having Ackerman geometry that allows one rudder to move more that the other while the associated marine hull is making a turn and the second rudder to move more than the first while making a turn in the opposite direction, for less disruption of the water and enhanced operating efficiency. Rearward movement of the

of the conical/tapered housing, with a plurality of recessed apertures around its perimeter that allow it to be placed flush within the bottom surface of a marine hull for most efficient and effective use, and its centrally positioned keyhole-shaped opening having tapering outside edges on its narrow end that cause a large volume of fluid to flow into the wider end of its conical/tapered housing without cavitation, the narrow end of the keyhole-shaped opening necessarily being positioned toward the bow of the marine hull into which it is mounted for maximum disruption of the laminar seawater flowing under the forward moving hull.

Fig. 5 is a plan view of the strut plate used over a rectangular access opening through the upper portion of the conical/tapered propeller housing of the most preferred embodiment of the present invention marine reaction thruster, with a plurality of fastener openings in a rectangular pattern being positioned near the perimeter of the strut plate, and the proximal end of the strut that is connected to the reverse side of the strut plate and used for supporting the distal end of the drive shaft upon which the propellers are mounted being centrally positioned and shown in broken lines.

Fig. 6 is a side view of one preferred embodiment of debris cutter contemplated for use with the propellers and/or strut in the most preferred embodiment of the present invention marine reaction thruster with its cutting edges configured for right~~left~~-hand rotation and a curved arrow showing the direction of its rotation, and with the cutter also having a means for a keyed attachment to the drive shaft upon which the propellers are mounted for movement in unison with the drive shaft and propellers.

Fig. 7 is a side view of the conical/tapered propeller housing in the most preferred embodiment of the present invention marine reaction thruster being secured between the bottom inside surface of a marine hull, a front casting supporting a drive shaft that extends into the housing,

insertion therethrough of drive shaft 6 and a rectangular-shaped cutout 52 configured to mate with key 18 on drive shaft 6. The rectangular shapes of key 18 and cutout 52 are not critical, as long as their configurations cause debris cutting member 16 to rotate in unison with drive shaft 6. It is contemplated for the cutting edges 50 of debris cutter 6 to be very sharp so that debris in seawater drawn through inlet opening 10 is sufficiently shredded to avoid becoming wrapped around the propeller 4 or strut 12 behind it and creating drag. Also, since in the most preferred embodiment 2 of the present invention the motor (not shown) connected to drive shaft 6 would always have a right~~left~~-hand rotation, an arrow in Fig. 6 shows the contemplated direction of rotation for all debris cutting members 16, and the uniform positioning of all sharp edges 50 on debris cutting members 16 in the direction of rotation. The materials from which debris cutting members 16 are made should be strong and corrosion-resistant, and a material that can hold a sharp edge so as to reduce maintenance. While the number of debris cutters used is not critical, periodic maintenance resulting from the need to clean drag-producing debris (not shown) from propellers 4A-4D is reduced by use of a debris cutting member 16 positioned for rotation in front of each successive propeller 4 and strut 12. It is considered to be within the scope of the present invention for the diameter dimension and configuration of cutting edges 50 of debris cutting members 16 to be selected according to the size of the propeller 4 or strut 12 with which it is being used. Fig. 7 shows the debris cutting member 16 positioned in front of strut 12 to be larger than the debris cutting members 16 positioned in front of propellers 4A-4D, however the sizes shown are not critical. Further, the thickness dimension of the debris cutting members used is not critical, and can vary according to the need.

Fig. 7 shows the conical/tapered housing 8 in the most preferred embodiment of the present invention marine reaction thruster having front casting 30 attached to its wider end and